

ICBioE'11

2nd International Conference on Biotechnology Engineering

17 – 19 May 2011
Legend Hotel, Kuala Lumpur, Malaysia

PROGRAMME BOOK

Organized by



Faculty of Engineering
International Islamic University Malaysia, IIUM

Website: <http://www.iium.edu.my/engineering>

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MESSAGE FROM THE CHAIRMAN OF ICBioE'11



Prof. Dr. Md. Zahangir Alam

Chairman, ICBioE'11

Faculty of Engineering

International Islamic University Malaysia (IIUM)

Assalamualaikum Warahmatullahi Wabarakatuh, and Warm Greetings,

I am extremely delighted that the Faculty of Engineering, International Islamic University Malaysia (IIUM) is organizing the 2nd International Conference on Biotechnology Engineering 2011 (ICBioE'11).

The conference theme '*Enhancing the Quality of Life through Emerging Biotechnology*' is hoped to create the links and collaboration among the researchers and industries through exploration of four key research areas of bioenvironmental, bioprocess, biomolecular and bionanotechnology engineering which not will enhance knowledge but also improve the quality of life with new processes and/or products.

On behalf of the ICBioE'11 organizing committee, we would like to extend a warm welcome to the distinguished speakers, participants and observers. We are pleased to announce that over 170 abstracts from more than 10 countries were received in which a total 130 technical papers have been accepted for oral presentation. With this large number of participants, this conference will provide opportunities for in-depth dialogue in the core areas of emerging biotechnology among practitioners in the biotechnology industry. It will also offer a unique platform for biotechnology professionals engaged in research, production of services and products, consultancy and education to share knowledge and ideas, to identify and update emerging issues.

I would like to take this opportunity to express my deepest regards to the members of organizing committee, members of the International and National Advisory Board, participants, observers, sponsors and reviewers whose involvement and cooperation have been invaluable in making this conference a success.

Wassalam

Prof. Dr. Md. Zahangir Alam

Chairman, ICBioE'11

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ICBioE'11 CONFERENCE SCHEDULE (DAY 3, 19 MAY 2011)

Parallel Session: BEE 5 (Bioenvironmental Engineering)	
Chairperson: Assoc. Prof. Dr. Nassereldeen Ahmed Kabbashi	
Co-chairperson: Dr. Mohammed Saedi Jami	
1030-1300 (Boardroom 1)	
ID	Title, Author(s) and Affiliation
99	Computers and Electronic Devices Waste: Analytical Study Shihab A. Hameed & Othman O. Khalifa. International Islamic University Malaysia, Malaysia.
106	Composting of Food and Yard Wastes by Locally Isolated Fungal Strains Opatokun Suraj Adebayo, Nassereldeen. A. Kabbashi, Md. Zahangir Alam, Aliyu Salihu, Alade Abass & Tijani I.R.D. International Islamic University Malaysia, Malaysia.
111	Process Optimization in Citric Acid Production Using Sewage Sludge as Fermentation Media Nur Hanis Mohamad Hanapi, Md. Zahangir Alam & Mohamed Ismail Abdul Karim. International Islamic University Malaysia, Malaysia.
122	Adsorption of Congo Red Onto Acid Activated Water Hyacinth Natarajan. Rajamohan ¹ , Marwan. M. Shamel ² & Abdelbaki. Benamor ¹ . ¹ Sohar University, Oman. ² Taylor's University, Malaysia.
123	Preliminary Test of Hydrocarbon Exposure on Salvinia molesta in Phytoremediation Process Israa Abdulwahab Albaldawi, Siti Rozaimah Sheikh Abdullah & Fatimah Suja'. Universiti Kebangsaan Malaysia, Malaysia.
129	Growth Kinetic Study and Modelling of Ethanol Production by <i>Saccharomyces cerevisiae</i> Farah Ahmad. International Islamic University Malaysia, Malaysia.
140	Development of Semifluidized Bed Bioreactor as Novel Bioreactor System for the Treatment of Palm Oil Mill Effluent (POME) Abass O. Alade, Ahmad T. Jameel, Suleyman A. Muyibi, Mohamed I. Abdul Karim & Md. Zahangir Alam. International Islamic University Malaysia, Malaysia.
145	Enzymatic Production of Xylitol and Future Prospects S. M. R. Islam ¹ , A. M. Mimi Sakinah ¹ & S. M. R. Islam ² . ¹ Universiti Malaysia Pahang, Malaysia. ² University of Chittagong, Bangladesh.
14	Visual Plumes Coastal Dispersion Modeling in South-West Sabah Zaki Zainudin International Islamic University Malaysia
6	Evaluation of compatible fungal mixed culture for composting process Noor Mohammad, Md. Zahangir Alam International Islamic University Malaysia

VISUAL PLUMES COASTAL DISPERSION MODELING IN SOUTH-WEST SABAH

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Abstract -

The model used for coastal dispersion modeling was the US EPA Visual Plumes model encompassing the DKHW (Davis, Kannberg, Hirst model for Windows) and Update Merge (UM3) sub-models. In theory, the dilution capacity of open waters, particularly coastal areas, straits and oceans are close to being infinite. This means that for surface and sub-merged point source discharges, the effluent concentration (C_e) will cause insignificant change in the overall ambient water quality. Instead, C_e will eventually reach C_a (ambient concentration) over a spatial distance (vertical and horizontal). This distance is of interest towards water quality preservation efforts as the macro level distribution effects of the pollutant species in question can be determined. The travel distance (l_t) is a main function of ambient current velocity (m/s) and direction. Prior to the modeling exercise, field data pertaining to ambient water quality, hydraulic characteristics and tide patterns were collected. The modeling results indicated that there would not be a significant change in ambient concentration for all constituents modeled when the effluent discharge is increased from 1,500 m³/hr to 2,400 m³/hr, as long as the current quality is maintained. The plume travel distance would also not entrain into foreign waters as long as proposed volumetric discharge rate is no violated.

Keywords : Visual Plumes, Coastal, Sabah

1.0 INTRODUCTION

DKHW applies to single and multi-port submerged discharges, which can be used in a three-dimensional setting. The program itself is a Fortran executable that is called by VP on demand. The model solves equation for plume size, trajectory, temperature and concentration using the Eulerian integral method, where the distance is considered to be an independent variable, unlike the Lagrangian formulation, where time is considered to be the independent variable (Baumgartner et al., 1994). By utilizing this approach, DKHW is able to provide detailed calculations in fully developed zone, as well as the Zone of Flow Establishment (ZFE) (Baumgartner et al., 1994). The model also considers gradual merging neighboring plumes in its computation proceedings.

UM3 is a Lagrangian model that utilizes the projected-area-entrainment (PAE) hypothesis, which quantifies subjugated entrainment and the rate at which mass, is integrated into the plume. The plume under such circumstances is assumed to be steady state. Under Lagrangian circumstances, this means that the continual elements will also follow a similar trajectory (Baumgartner et al., 1994).

2.0 METHODOLOGY

In theory, the dilution capacity of open waters, particularly coastal areas, straits and oceans are assumed to be approaching infinity (ambient concentration) (Davis, 1999). This means that for surface and sub-merged point source discharges, the effluent concentration (C_e) will cause insignificant change in the overall ambient water quality. Instead, C_e will eventually reach C_a

(ambient concentration) over a spatial distance (vertical and horizontal). This distance is of interest towards water quality preservation efforts so that the macro level distribution characteristics of the pollutant species in question can be determined (Frick and Winiarski, 1976). The travel distance (l_t) is a main function of ambient current velocity (m/s) and direction (Merz, 2004). Prior to the modeling exercise, field data pertaining to ambient water quality, hydraulic characteristics and tide patterns were collected (Rawn et al., 1960). Several scenarios that were simulated include:

- i. **Variable Maritime Hydraulic Conditions** : Variation in ambient velocity to determine maximum plume centerline distance (from diffuser) at 0.108 m/s (field-measurement), 0.216 m/s and 0.500 m/s at a trajectory towards most sensitive receptor (Brunei waters).
- ii. **Proposed Operating Conditions** : Submerged discharges (1 diffuser, 40 m port spacing) with variable discharge quality (refer Table 2.1) at proposed flow of 0.6667 m³/s at ambient velocity of 0.5 m/s and low-tide conditions (minimum depth of diffuser).
- iii. **Worst Case Scenario** : Submerged discharges (1 diffuser, 40 m port spacing) with variable discharge quality (refer Table 1) at 5.0 m³/s with ambient velocity at 0.5 m/s and low-tide conditions (minimum depth of diffuser).

Table 1 : Variable Discharge Quality Simulated

BOD (mg/l)	COD (mg/l)	TSS (mg/l)
50, 100, 250, 500	500, 700, 1000, 1500	50, 100, 300, 500

The coastal dispersion modeling exercise is based on existing submerged diffuser located parallel to the study area jetty (Figure 1). Modeling assumptions, among others:

- i. Buoyant plume characteristics (in accordance with the DKHW model).
- ii. The plume is heterogeneously distributed.
- iii. The plume movement and dispersion is in line with the DKHW and UM-3 mathematical considerations.

3.0 DISCUSSION

Based on the maritime hydrological survey conducted, the following plume distribution pattern was generated from the Visual Plumes (VP) DKHW modeling exercise. It was observed that even under worst-case-scenario conditions with at maximum tidal velocity of 0.500 m/s towards the north-east (Brunei waters), the plume would only travel a maximum distance of about 30 meters before hitting the surface (Figure 2). Not surprisingly, an increment in ambient velocity resulted in a larger spatial distance prior to hitting the surface (Figure 3). Although this may be the case, an increment in plume diameter (boundary) and thus pollutant distribution was observed. The maximum plume diameter was modeled to be at approximately 17.83 meters. Comparison with the UM-3 (less conservative model, built more specifically for estuarine conditions) resulted in a similar outcome (Figure 4), albeit a smaller plume diameter (13.53 meters).

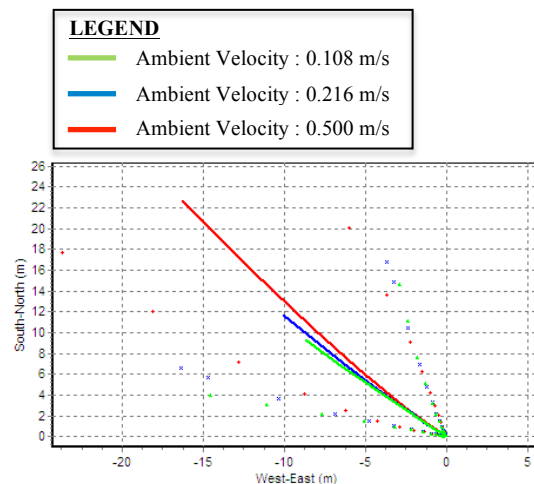


Figure 2 : Plume Movement from Source (DKHW Model)

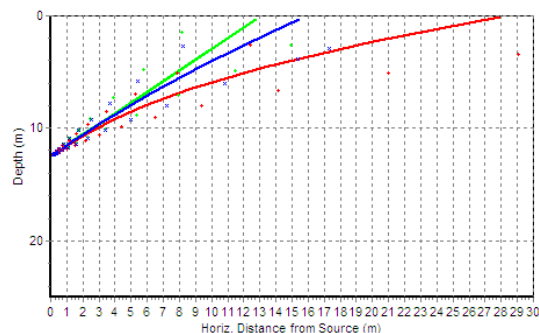


Figure 3 : Plume Horizontal Distance from Source (DKHW Model)



Figure 1 : Study Area (Sipitang District, Sabah)

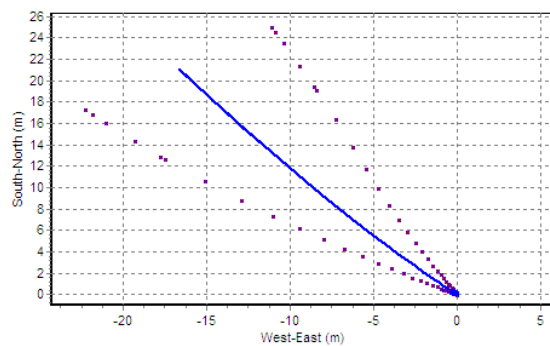


Figure 4 : Plume Movement from Source
(Ambient Velocity = 0.500 m/s, UM-3 Model)

For BOD₅, the VP modeling results indicated that an increase in operational capacity of the pulp and paper mill would not result in a detrimental increment along the center-line (Figure 5). Only in the event of a failure of the treatment system, with BOD₅ effluent being released at 250 mg/l (and higher) would a significant change along the centre-line be observable, before subsequent surface penetration. This immense dilution potential was consistent with other studies such as by Merz (2004), where dilutions from outfall were predicted at a ratio of 160:1. The ambient BOD₅ near surface concentration increment (ΔC) for this scenario was approximately 0.40 mg/l. This constituent simulation as well as the proceedings below was based on the worst-case-scenario assumption with a tidal velocity of 0.500 m/s.

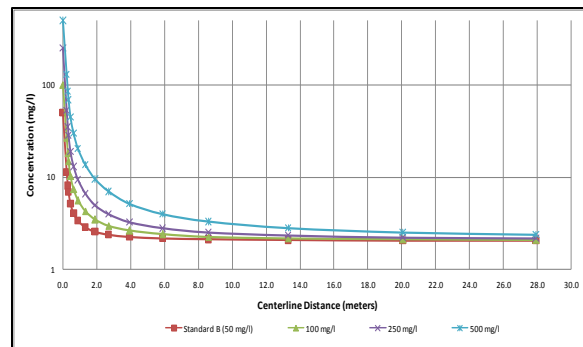


Figure 5 : BOD₅ Dilution Change with
Centerline Distance
(Proposed Discharge Flow, $Q = 0.6667 \text{ m}^3/\text{s}$)

Referring to Table 2, even if the effluent BOD₅ was released at 500 mg/l the effects upon hitting the water surface would be relatively marginal, with no distinctive difference compared to the Standard B and 100 mg/l scenarios. However, the contemporary effluent quality compliance of 20 mg/l should be maintained, to avoid organic pollutant build-up in the long run and avoiding over-nuttrification of the bay area (Sawyer et al., 2003).

Table 2 : Predicted Surface BOD₅ Concentration for Various Effluent Discharge Qualities at Normal Discharge Flow (0.6667 m³/s)

Centerline Distance (m)	Standard B (50 mg/l)	100 mg/l	250 mg/l	500 mg/l
27.93	2.03	2.07	2.14	2.36

4.0 CONCLUSIONS

The modeling results indicated that there would not be a significant change in ambient concentration for all constituents modeled when the effluent discharge is increased from 1,500 m³/hr to 2,400 m³/hr, as long as the current quality is maintained. The plume travel distance would also not entrain into foreign waters as long as proposed volumetric discharge rate is not violated. It is recommended therefore that the BOD₅ discharge quality to not exceed 20 mg/l, COD to not exceed 250 mg/l and TSS to not exceed 50 mg/l to maintain the current ambient quality.

Albeit being the case, the pulp and paper mill is advised to review its current COD discharge quality of about 250 mg/l as is still relatively high. Since COD encapsulates various other chemically oxidizable parameters, decrement of this constituent will no doubt reduce the impact of other constituents not modeled towards the bay area as well as diminish organic build-up and bio-accumulation.

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